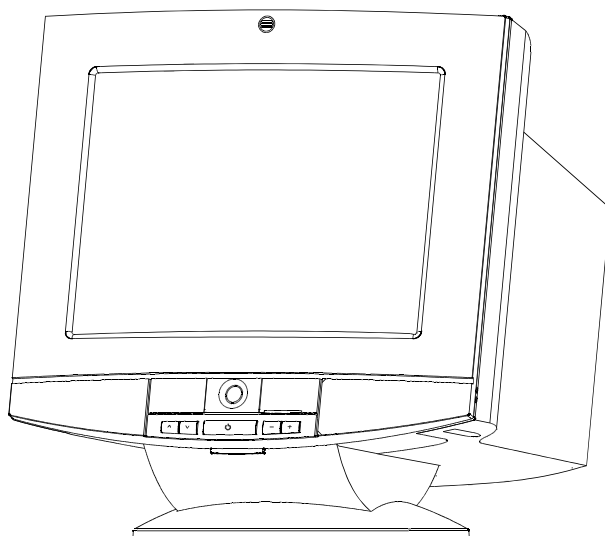


Service Manual

Nokia Display Products Oy
PB 14
SF-24101 Salo, Finland

Chassis 447K, 447Q

17" High Resolution Color Monitor



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Part List
PCB Part List
PCB Layout pictures

Level

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Main Board module SMA163F/166F/175F
CRT module SMH129B
Video amplifier module ... SMY030E
Subwoofer module SMZ038A

SMA163I/166I/175I/194
SMH129C
SMY030G
SMZ038D

Service

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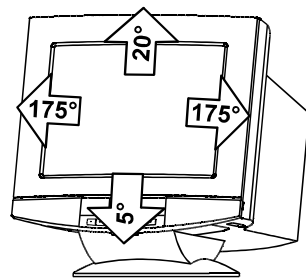
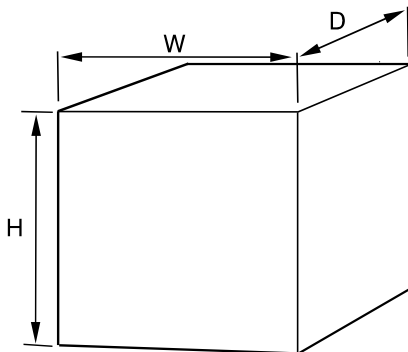
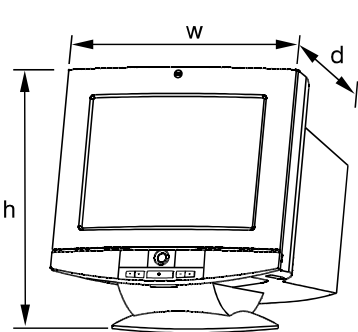
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1. Product Overview

447K is a 17 inch monitor with optional videocamera and sound reproducing feature. The maximum resolution of 1280 x 1024 makes the monitor suitable for PC applications using graphical user interfaces. The monitor has an own power supply with input voltage requirements from 90V to 264V.

1.1. Technical Specifications

Cathode Ray Tube	17" in diagonal, 90° deflection angle
	Dark, antiglare, antistatic coating
	Short persistence (P22)
	Dot pitch 0.25 mm
Picture Size	300 mm x 225 mm with specified geometric distortion
Maximum Picture Size	321 mm x 236.5 mm, diagonally 398 mm (15.7")
Power Input Requirements	Voltage 90–127/195–264 V, 60/50 Hz Autosense
	Current 2.0 A/110 V, 1.0 A/240 V
	Inrush current max. <40 A (peak)
Power Dissipation	< 150 W Normal Operation
	~70 W Stand-by
	< 30 W Suspend
	< 5 W Auto power off
Memory Locations	14 for factory preset timings (8 in use 6 free)
	18 for user adjusted timings
Geometric Distortion	The distance between bezel and active screen edge shall not vary more than 2 mm in both vertical and horizontal dimensions
Luminance	Min. 95 cdm ⁻² at center, with full white field
Video Input	Input Signal: RGB, analog, positive, max 0.7 V/75 Ω
	Horizontal addressability: 1280 dots maximum
	Vertical addressability: 1024 dots maximum
Synchronization Range	Horizontal: 31 kHz to 91 kHz automatic
	Vertical: 50 Hz to 150 Hz automatic
Synchronization Signal	Separate TTL, positive/negative
	Composite TTL, positive/negative
Max. Dot Frequency Capability	>140 MHz
Temperature	Operating: +10°C to +40°C
	Packed: -20°C to +60°C
Humidity	Operating: 15% to 85 %
	Packed: 5% to 95 %
Weight	22 kg net
	25 kg gross
Size, Tilt and Swivel	



Dimensions

Monitor	h	438 mm
	w	430 mm
	d	478 mm
Package	H	571 mm
	W	540 mm
	D	596 mm

Audio option

Output power 2 x 2 W

when input signal is 0.7 Vrms on AUDIO IN

Sensitivity of internal – 5 dB (0 dB = 1 V at MIC OUT connector
microphone system with 1 Pa sound pressure in the microphone)

External microphone (not part of audio option delivery !)

Jack Ø 3.5 mm

Type Electret condenser microphone

Feeding voltage 6 V

Current consumption max 0.3 A

Headphones (not part of audio option delivery)

Impedance 8 to 600 ohms

Jack Ø 3.5 mm

Video camera option

Camera CCD with internal synchronizing system

Picture elements

Horizontal 500

Vertical 582

Sensitivity min. 5 lux (F 1.2)

Colour system PAL

Video output (CAMERA VIDEO OUT)

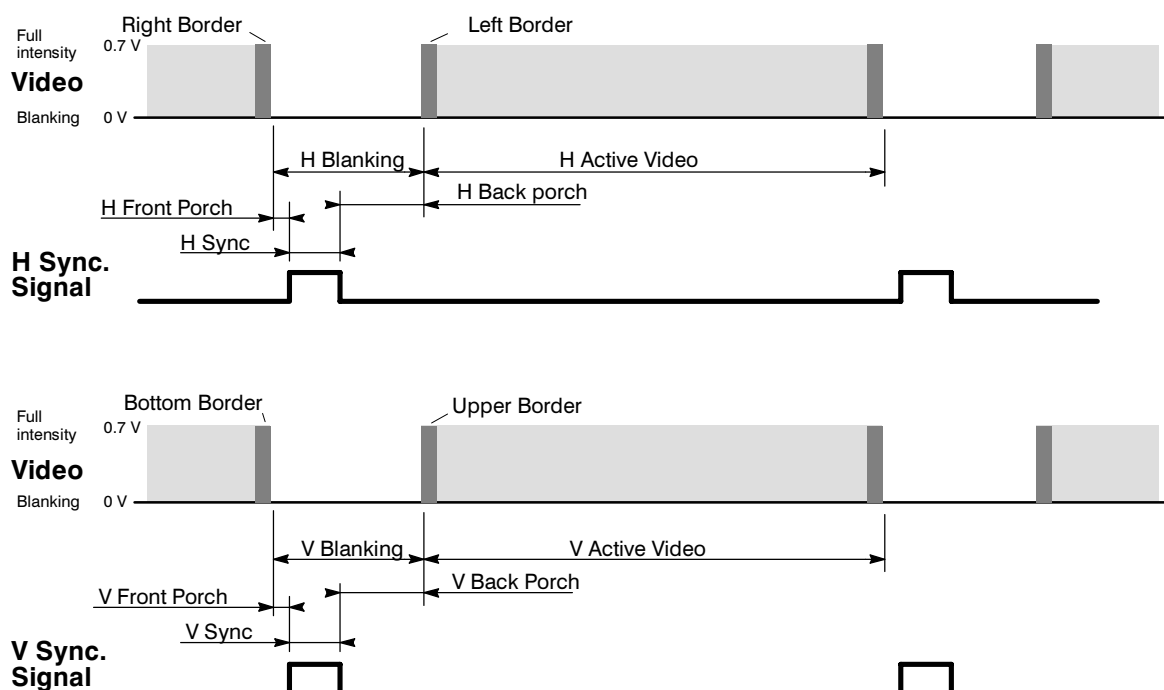
Signal type Composite, negative sync.

Output 1.0 Vpp / 75 ohms

Connector RCA

Specifications are subject to change without notice.

1.2. Preset Display Modes



Display Mode →	1	2	3	4	5	6	7	8
Display Mode Name	NCE611	NCE560	NCE561	NCE506	NCE402	NCE300	NCE360	NCE011
H Frequency/kHz	74.607	58.140	61.101	60.023	48.077	31.472	39.409	68.681
H Period/ μ s	13.404	17.200	16.366	16.660	20.800	31.774	25.375	14.560
H Active Video/ μ s	10.260	12.800	11.903	13.003	16.000	25.420	20.300	11.520
H Resolution	1280	1024	1024	1024	800	640	640	1152
H Sync/ μ s	0.89	3.60	3.72	1.22	2.40	3.81	3.04	1.28
H Back Porch/ μ s	1.75	0.60	0.66	2.23	1.28	1.91	1.52	1.44
V Period/Lines	1066	807	806	800	666	525	525	915
V Resolution	1024	768	768	768	600	480	480	870
V Sync/Lines	5	8	8	3	6	2	2	3
V Back Porch/Lines	36	31	30	28	23	33	33	39
H sync Polarity	+	+	+	+	+	-	-	-
V sync Polarity	+	+	+	+	+	-	-	-
H Front Porch/ μ s	0.50	0.2	0.08	0.20	1.12	0.64	0.52	0.32
V Front Porch/Lines	1	1	1	1	37	10	10	3
Dot Frequency/MHz	125.340	80.000	86.030	78.750	50.000	25.177	31.528	100.000
Interlacing	no	no	no	no	no	no	no	no

1.3. Monitor Connection

Make sure that the monitor is disconnected from mains and the power switches of the computer and all attached devices are turned off before connecting the monitor.

1. Connect the signal cable plug to the videocontroller connector at the back of the computer.
2. Tighten the screws on the plug by hand.
3. Connect the power cord first to the monitor and then to a grounded power outlet.

If your monitor is DDC compatible (PC)

- Do not use any adapter when connecting signal cable to your computer.
- Do not extend the signal cable with extension lead. The DDC signals will not accept extended cable.

If there is no DDC in your computer (PC)

- Normally there is no need for adaptor when connecting signal cable to your computer.
- Use a XGA–2 adaptor in the signal cable if you are going to use XGA–2 display mode (1024 x 768, 75 Hz)
- Use MAC adaptor in signal cable when connecting the monitor to an Apple Macintosh computer.

ACCESS.bus connector

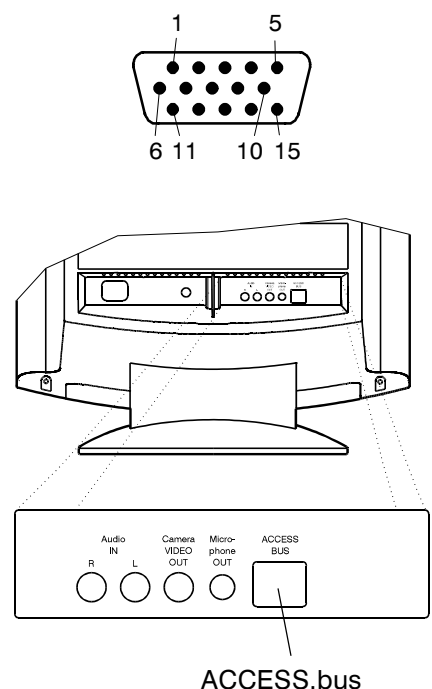
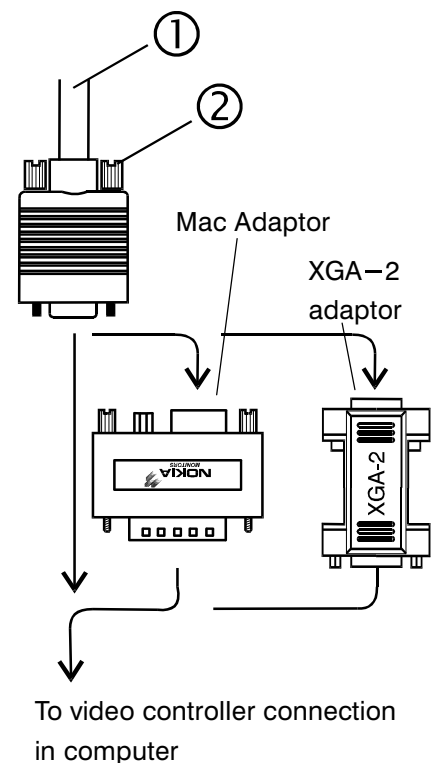
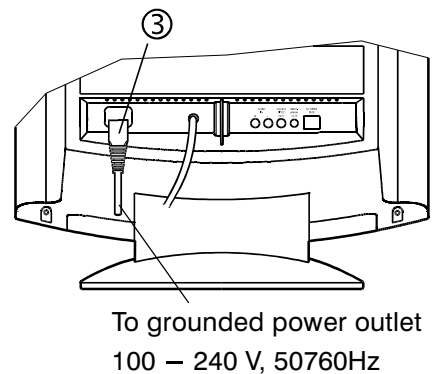
The monitor has been equipped with ACCESS.bus connector in the connector panel. You may plug other DDC level 2AB compatible equipments (e.g. mouse) there.

Signal connector

Pin		Signal
1	→	RV Red video
2	→	GV Green video
3	→	BV Blue video
4	<–	ID2 ID2 (tied to LG with 332 ohms inside monitor)
5		ST DDC GND
6		RG Red ground
7		GG Green ground
8		BG Blue ground
9	→	+ 5V
10		LG Logic ground
11	<–	ID0 ID0 (tied to LG with 332 ohms inside monitor)
12	<–	SDA DDC SDA
13	→	Hs Hor. sync., Comp. sync.
14	→	Vs Vert. sync.
15	<–	SCL DDC SCL

ACCESS.bus

Pin	Signal
1	Ground
2	DDC SDA (I ² C signal)
3	+ 5V
4	DDC SCL (I ² C signal)



1.4. Audio Features Option

The Monitor has built-in basic audio features. In business and multimedia systems this is an advantage because external speakers, microphone and connection do not clutter your desktop.

Before making any connections, switch off the computer and monitor with the power switch.

As an example the illustration shows connection to a computer sound board (Sound Blaster, Creative Labs, Inc.) Note that other types of sound boards may use different names for connectors.

The monitor can be connected to any other sound system if the signal levels and impedances are taken into account.

Incoming sound

The incoming sound system is capable to procedure stereo sound via loudspeaker L and R.

In the right hand side of the monitor there is a jack for headphones. Inserting of the headphones plug silences the loudspeakers.

Connect the audio inputs Audio IN L/R of the monitor to the audio output (Line Out) in the computer.

Outgoing sound

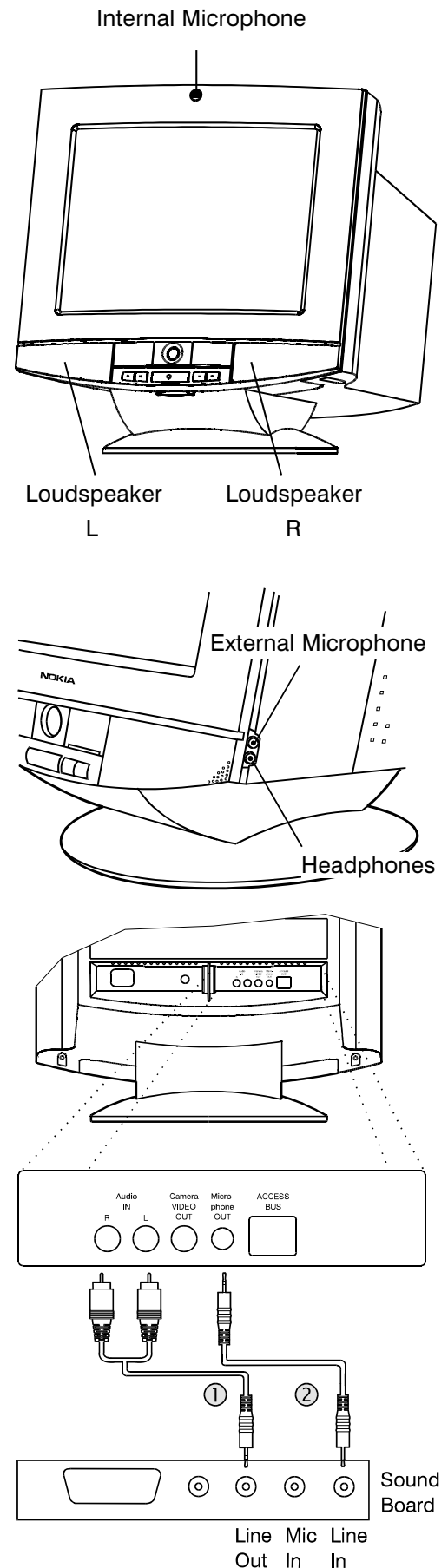
The monitor has built-in microphone.

If you use external microphone (electret condenser mic), plug it into the jack on the right hand side of the monitor. Inserting of the microphone plug switches off the internal microphone.

Connect the microphone output Microphone OUT of the monitor to the line level sound input (Line IN) in the computer. If the Line In jack is occupied, try microphone input jack (Mic in).

Note

Sound Board, headphones, external microphone and connection cables are not part of monitor delivery even in case the monitor includes audio features.



1.5. Video Camera Option

Video camera offers PAL composite signal which can be used e.g. for

- Video conference together with audio features.
- Video recording with ordinary video recorder.
- Signal source for computer video capture card in case the card accepts composite signal.

The camera objective can be closed with lever operated lid. The lid is intended to operate as a shield for objective when the camera is not in use. When closed it gives a possibility for the user to be absolute privacy without danger of somebody watching you.

The camera can be angled towards the object horizontally by swivelling the monitor in its base and vertically by a lever under the bezel.

1.5.1. Connections

Adjust focus with help of a TV-set equipment with a SCART connector

Nokia Parts cable set P/N 81V029 can be used for connection to the TV-set but if not available, build your own cable.

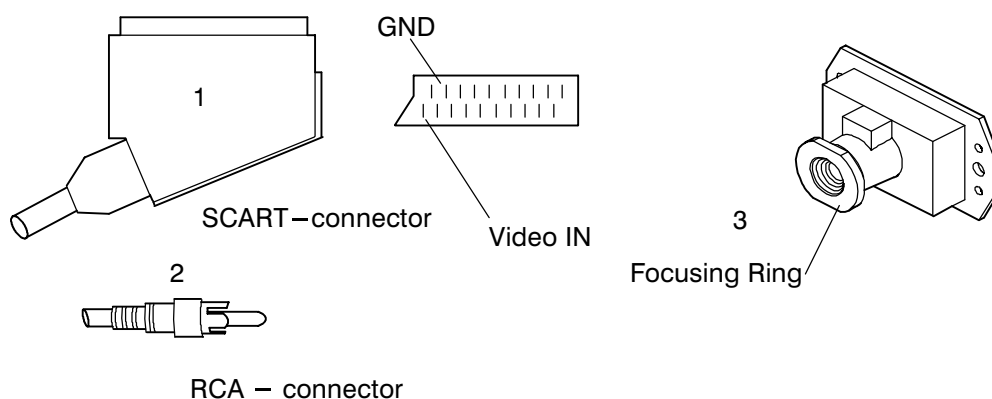
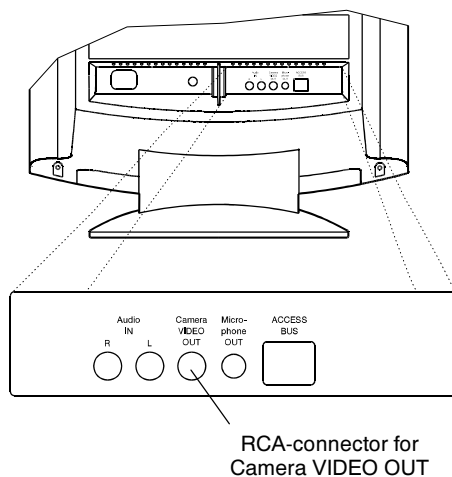
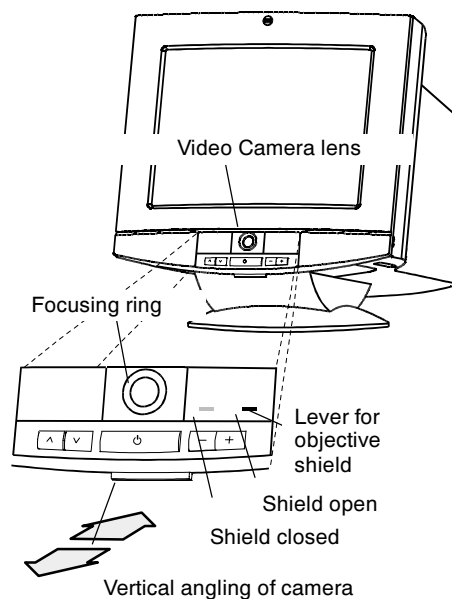
1. Attach the SCART connector to the TV-set.
2. Attach the Video IN RCA connector to the Monitor Camera VIDEO OUT
3. Adjust focus.

1.5.2. Focusing Camera

The camera can be focused to the target by turning the focusing ring (black) with fingertip.

- Turning the ring clockwise gives a sharp picture from targets which are farther.
- Turning the ring counterclockwise focuses the camera to the targets which are near.

If you can not find a position with good focus, turn the focus ring clockwise to the limit. Turn the ring 4 turns backwards.



1.6. User Controls

1.6.1. Power Switch

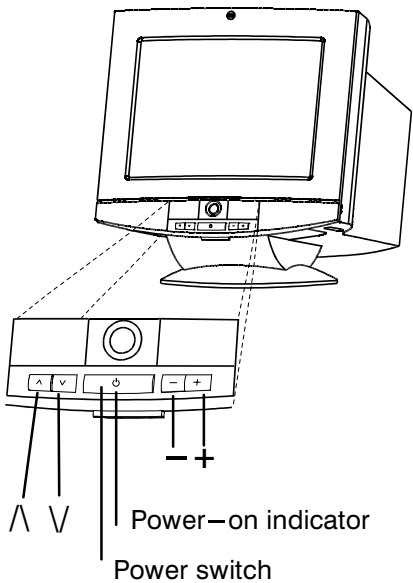
Turning the Monitor ON and OFF

Push the **power switch** to turn the monitor on or off

When the power is turned on, the **power-on indicator** will light.

The colour of the the power-on light indicates the operating state of the monitor.

- Green The monitor is in normal operation
- Orange The monitor is in automatic power off state
- Not illuminated . . The monitor is turned off with power switch or disconnected from mains outlet.



If the power management function working properly in your computer, you do not need to switch the monitor on or off. It happens automatically.

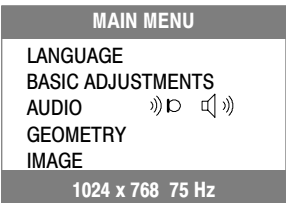


The power switch does not disconnect the monitor from mains. In oder to make the monitor completely powerless, unplug the power cord from power outlet.

1.6.2. Main Menu

The adjustments and settings of the monitor are carried out using menu display. The menu is called on the screen by pushing v or ^ button.

Each line in the MAIN MENU contains a header of another menu. Footer line contains information about the display mode currently in use. Nothing can be adjusted directly in this menu.



Submenu

- 1 Select the header which contains the adjustment you are looking for (e.g. BASIC ADJUSTMENTS) with ∇ or $\wedge$. The selected item in the menu is indicated with triangles $\blacktriangleright$ and $\blacktriangleleft$.
- 2 Open the selected submenu with + or - button.
- 3 Select the property you want to adjust with ∇ or $\wedge$ (e.g. WIDTH).
- 4 Adjust the selected property (WIDTH) with + or -. The menu disappears and a scale shows the position of the adjustment.

The + button increases and - button decreases the property.

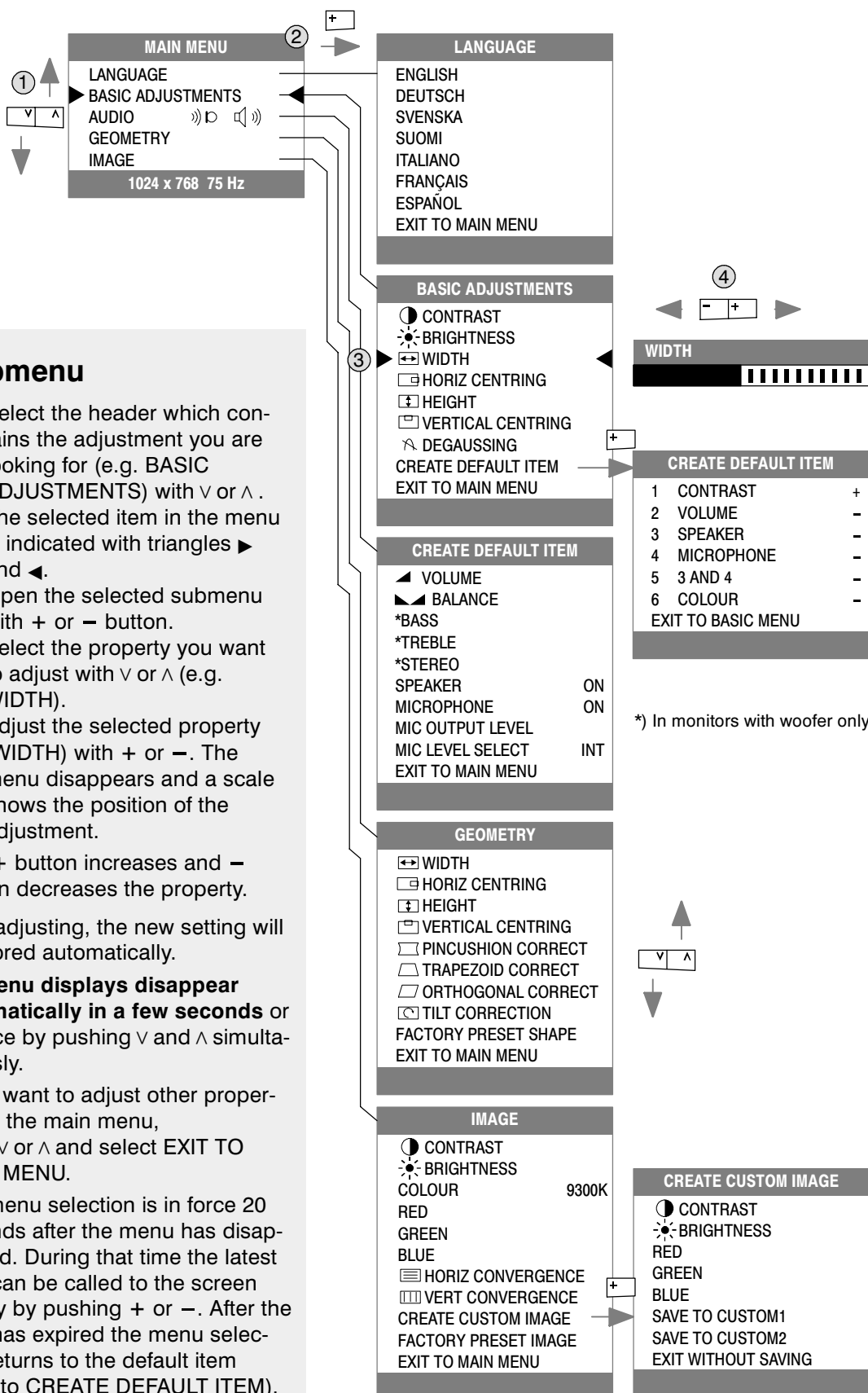
After adjusting, the new setting will be stored automatically.

All menu displays disappear automatically in a few seconds or at once by pushing ∇ and $\wedge$ simultaneously.

If you want to adjust other properties in the main menu, push ∇ or $\wedge$ and select EXIT TO MAIN MENU.

The menu selection is in force 20 seconds after the menu has disappeared. During that time the latest item can be called to the screen simply by pushing + or -. After the time has expired the menu selection returns to the default item (refer to CREATE DEFAULT ITEM).

Some of the menu items consist of selection alternatives. + scans the alternatives upwards and - downwards. If there are only two alternatives, + button switches the property ON and - button OFF.



2. Site Preparation

2.1. Location

This Monitor is designed for normal office conditions. It is equipped with own power supply. It is not to be serviced or repaired on site

2.2. Troubleshooting

Local service facilities should perform simple maintenance such as trimming. More advanced maintenance and repair that requires replacement of components which in turn requires testing and re-trimming should be carried out in a central workshop.

Symptom		Measures
Picture screen is blank	The indicator on the front panel is not illuminated	Check that the power cord is correctly connected to the monitor and to the power outlet. If the monitor is powered through the computer, check that the computer is switched on with the mains switch. Use a desk light, for example, to verify that current is connected to a power outlet. If no electricity is connected to the outlet, call an electrician.
		Unplug the monitor from power outlet for about one minute.
	The indicator on the front panel is illuminated	The monitor might be in stand-by position. Push one of the buttons or move the mouse.
		Check that the keyboard's connection to the computer is OK.
		Check that the signal cable connector is connected. If the connector is loose, tighten the connector's screws.
		Unplug the monitor from power outlet for about one minute.
		Switch off the monitor and the computer. Remove the signal cable from the computer. Switch on the monitor using the power switch. If a gray, slightly blinking frame (background) appears on the screen, it is evident that the monitor functions correctly and the problem is caused by an error in other parts of the system.
		Check the signal cable's connection pins. If the pins are slightly distorted, use nose pliers to straighten them.
		The computer may use a timing values which are out of the monitor's synchronization range.
Picture has colour defects	Demagnetize the monitor	
	If colour defect is repeated without the monitor having been moved, it is possible that the monitor is influenced by a strong magnetic interference field (near to a high power cable, for example). Try to find a better location for the monitor or the interference source. Note that another monitor placed too near (less than 30 cm.) may also generate interference in the picture.	
Picture is stable but distorted	Your computer may use a timing for which the corresponding picture characteristic adjustments have not been set at the factory. Adjust the picture characteristics	
Picture is unstable	Make sure your computer and video card are properly configured for your monitor	
	Check the proximity of other electrical devices that generate magnetic fields, such as speakers, other monitors, electric fans and fluorescent light fixtures.	
Picture is black and white	Check that the signal cable's connector is completely inserted. Switch off the computer and restart.	

2.3. Checking the Operation of PowerSaver

The proper operation of the function requires a computer with VESA DPMS power management capabilities. Note that the power saving feature must be activated in the computer when checking the operation.

State	Colour of the power-on indicator	5V	7V	12V	Video
Normal Operation	Green	Yes	Yes	Yes	Yes
Stand-by	Green	Yes	Yes	Yes	No
Suspend	Green	Yes	Yes	No	No
Power Off	Orange	Yes	No	No	No

DPMS (Display Power Management Signaling) is a trade mark of Video Electronics Standard Association (VESA)

3. Controlling the Memory for Picture Adjustments

The picture adjustment values are stored in non-volatile memory. The memory has separated areas for User Adjustments and for Factory Adjustments.

3.1. Memory for User Adjustments

3.1.1. Adjustment

- [1] If there are values available in the memory for user adjustments, corresponding to the present timing signals, they are always used.
- [2] New user made adjustments are stored to the memory for user adjustments.

3.1.2. Resetting the User made settings for geometry or image

- [3] User memory can be emptied from user made settings. **Resetting affects only the timing which is currently active.** The reset function is inhibited if no corresponding factory preset display mode exists. Please refer to chapter "User controls".

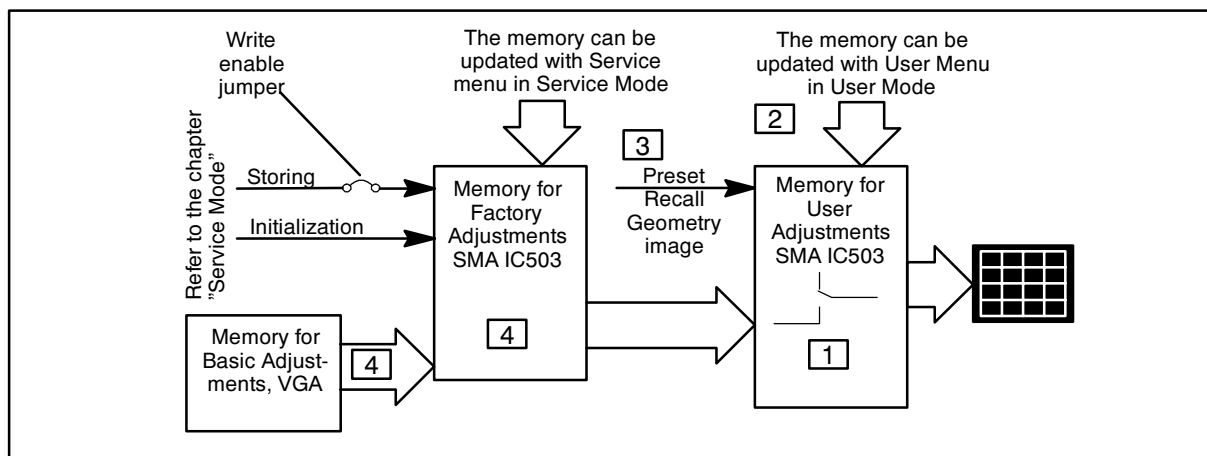
After resetting all picture properties are coming from memory for factory adjustments.

3.2. Memory for Factory Adjustments

All measures to the factory adjustments require that the write protection jumper must be connected.

3.2.1. Adjustment

- [4] Factory adjustments can be updated with service menu in service mode. If there is no location in factory adjustment memory for timings currently in use, the adjustment affects the memory for user adjustments.
 - If the memory location mentioned in case [1] is empty, the picture adjustment values are read from memory for factory adjustments. Factory adjustments, corresponding to the current timings, are transferred to user memory if any picture property is adjusted. After that the operation is as in case [1].



4. Service Mode

Service Mode is needed for updating of the factory adjustments for timings listed in the chapter Pre-set Display Modes. If there is no location in factory adjustment memory for display mode currently in use, the adjustment affects the memory for user adjustments.

4.1. Grouping of the Adjustments

There are two groups of software adjustments in service mode:

- geometry adjustment set
- grey scale adjustment set

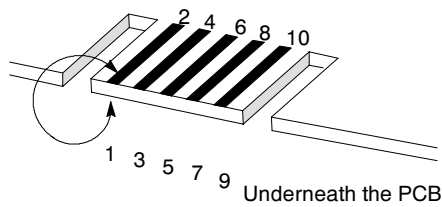
The following table shows how the adjustments act in relation to the display modes.

Adjustment	Common for all Display modes	Separate for each Display mode	Available in User Mode	Available in Service Mode
Contrast	X		X (Common memory for both modes)	
Brightness	X		X (Common memory for both modes)	
Horizontal centring		X	X	X
Vertical centring		X	X	X
Height		X	X	X
Width		X	X	X
Pincushion		X	X	X
Trapezium		X	X	X
Orthogonality		X	X	X
Horizontal convergence	X		X	X
Vertical convergence	X		X	X
Pincushion balance		X		X
Horizontal raster centring	X			X
G2	X			X
Max/Min contrast	X			X
R Blacklevel	X			X
G Blacklevel	X			X
B Blacklevel	X			X
R Gain	X			X
G Gain	X			X
B Gain	X			X

Common adjustments need to be adjusted only once. Separate adjustment must be performed for every display mode to be stored.

4.2. Write Enable Jumper

Memorizing in Service Mode requires that service connector pins 1 and 2 must be short circuited. Make the short—circuit before you start service mode and disconnect it after you have completed the whole adjustment procedure.

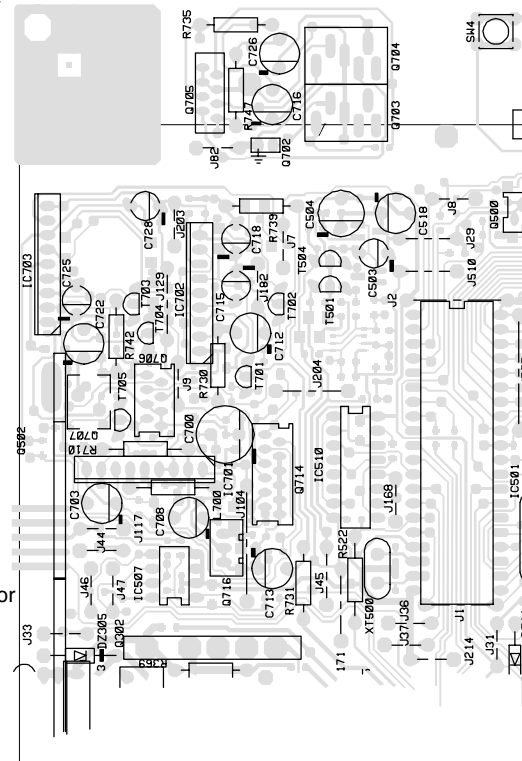


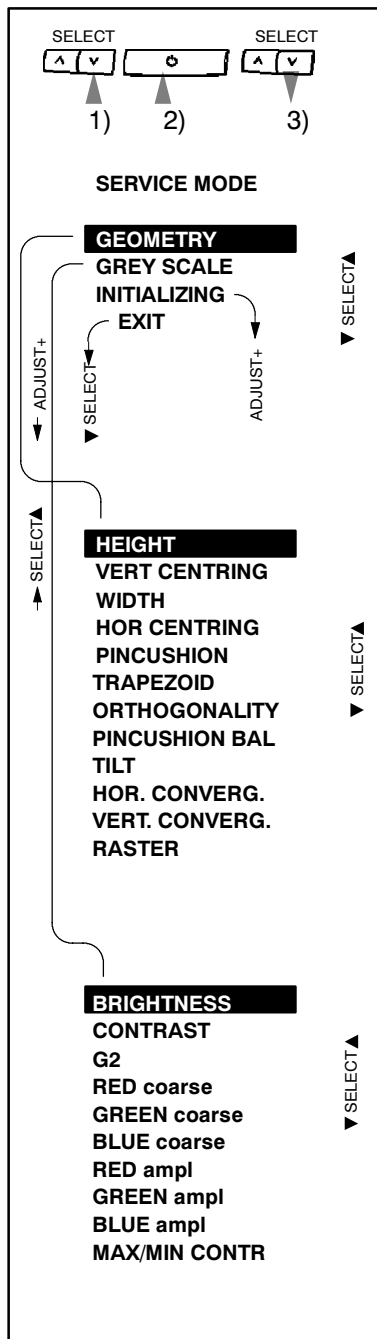
Write Enable Jumper
Make a short circuit between 1 & 2

Note
Forgetting to disconnect the short circuit may cause corruption of the memory content during normal use.

Front edge of
the SMA

Service
Connector





4.3. Service Menu

4.3.1. Access to Service Mode

First switch OFF the monitor with power switch.

- 1) Push ∇ SELECT down
- 2) While keeping ∇ SELECT down, switch ON the monitor
- 3) Release ∇ SELECT **after service menu has appeared** to the screen.

Select the items in the menu with SELECT button. Push ADJUST+ to open Geometry or Grey Scale Submenu or to Initialize the memory IC. Adjust each property with $-$ ADJUST+.

4.3.2. Geometry

Geometry submenu contains placement, size and shape adjustments.

4.3.3. Grey Scale

This monitor has six preset tints. With tint numbers smaller than 4 the picture becomes reddish and with tint numbers greater than 4 the picture turns blue.

Tint no	1	2	3	4	5	6	7
Colour Temperature	5000K	6000K	6500K	7000K	8000K	9300K	10000K

The grey scale adjustment affects directly tint number 6 (9300K) only. Other tints are derived automatically from 9300K colour temperature.

4.3.4. Initializing the Replacement IC503 on SMA board

If the memory for factory adjustments is replaced, it must be initialized. During initializing all memory locations are written with approximate values. They must be updated in service mode as explained in the chapter 'Adjustment Procedure'.

- Activate service mode as explained before.
- Select INITIALIZING in the service mode menu with SELECT button.
- Initialization of the memory by pushing + button
- Switch OFF the monitor

Caution

Initializing of a programmed memory IC deletes all user and factory made adjustments.

4.3.5. Monitor Type Setting

- After initializing the monitor continue with the setting of the monitor version to the memory.
- Switch the monitor off
- While keeping setting button(s) down, switch the monitor ON.

- Setting buttons:

447K051 (447Xavc)	ADJUST +
447K151 (447Xa)	ADJUST –
447K059 (447Xavc)	SELECT ∧ and ADJUST +
447K159 (447XXav)	SELECT ∧ and ADJUST –
447Q051 (447Xi)	ADJUST –
447R051 (417M)	ADJUST +
447Q059 (447Xi)	SELECT ∧ and ADJUST +

- Setting buttons since Firm Ware 1.3

447K051 (447Xavc)	ADJUST +
447K151 (447Xa)	ADJUST –
447K059 (447Xavc)	SELECT ∧ and ADJUST +
447K153 (447Xav)	SELECT ∧ and ADJUST –
447K159 (447Xav)	SELECT ∧ and ADJUST –
447Q051 (447Xi)	SELECT ∧ and ADJUST +
447Q059 (447Xi)	SELECT ∧ and ADJUST +

- Switch the monitor off

4.3.6. Storing and Returning to the User Mode

The display related adjustments are stored at the moment of return to the head menu from a submenu. Common adjustments are stored at the moment when you leave Service Mode. Display modes can be changed without leaving Service Mode when making display mode related adjustments. Exit from Service Mode by selecting EXIT in the service mode menu and pushing ∨ SELECT.

When you exit from Service Mode, the monitor turns to normal user mode. If you want to leave the service mode without memorizing common adjustments, switch off the monitor in service mode.

5. Workshop Maintenance

5.1. Important Safety Notice

The components, which are important for safety, are marked with special mark  on the circuit diagram. It is essential that these critical parts should be replaced with manufacture's specified parts to prevent X-radiation, shock, fire or other hazards.

For your own safety, use always safety isolating transformer when repairing the monitor.

5.1.1. Discharging the CRT

High voltage circuitry includes bleeder resistor which normally discharges the tube in about 5 seconds after the power is switched off. If you – for safety reasons – want to be sure about the discharging, do as follows:

Wear safety goggles. A cracked CRT may implode when discharged.

The signal cable must be disconnected from the computer.

To discharge the CRT, a flat-head screwdriver with grounding cable is required.

- Disconnect the power cable.
- Connect the metal chassis of the monitor to reliable earth.
- Connect the grounding wire to the screwdriver.
- Connect the other end of the grounding wire to the chassis (earth).
- Insert the screwdriver under the rubber cap of the EHT connector to discharge the tube.
- Disconnect the power cable.

5.2. ESD–Sensitive Parts

To prevent damage, when working with electrostatic discharge (ESD) sensitive parts, observe the following instructions:

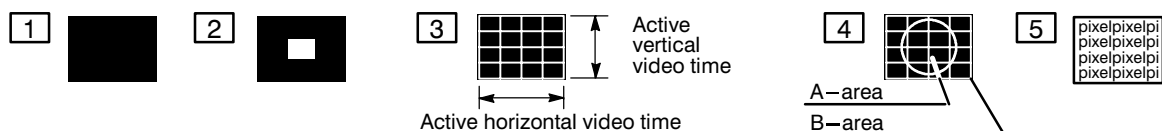
- Keep the ESD-sensitive part in its original shipping container until you are ready to install the part into the component card.
- Just before touching the ESD-sensitive part, discharge to the monitor any static electricity in your body; do this by touching the metal frame or cover of the machine. If possible, keep one hand on the frame when inserting or removing a logic card, for example.
- Hold the ESD-sensitive part by its edge; do not touch its pins.

5.3. Test Equipment

The following test equipment are required to adjustment procedure.

- Safety isolating transformer
- Digital multimeter: Fluke 87 or equivalent true RMS multimeter
- High voltage probe: e.g. Fluke 80–40k
- Signal generator: VTG220 + PC or programmable video generator
- Color analyzer: e.g. Minolta TV Color Analyzer CA100
- Convergence Gauge (CM7AR or equivalent)
- Oscilloscope 40–100 MHz band width
- Hi–Pot tester (Flash tester with insulation measurement / Leakage current / Break down voltage)
- ESD protection necessary

5.4. Test Patterns



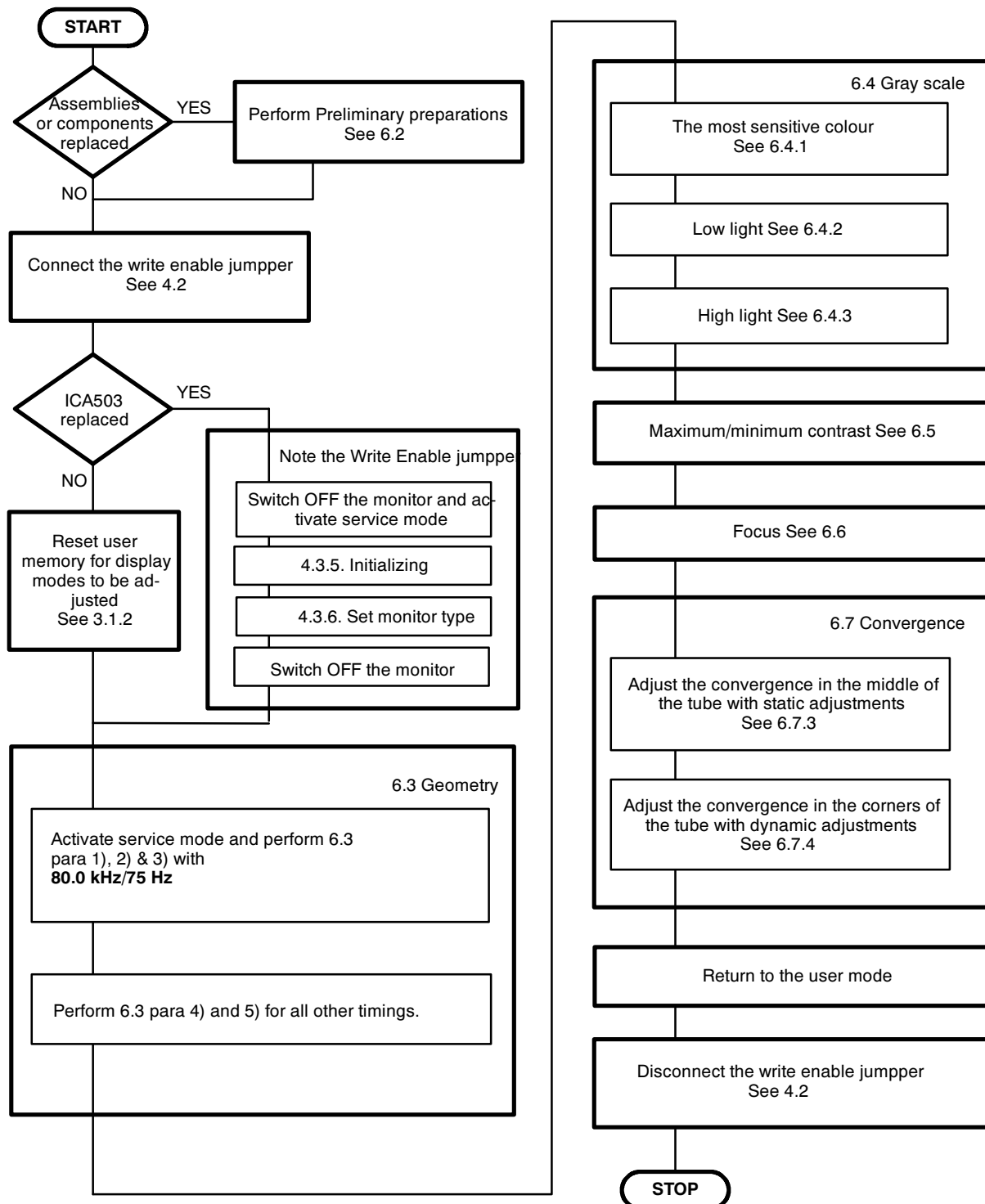
- 1** Black Picture
 - Signal level = 0 V at each RGB input
- 2** Highlight grey scale tracking
 - Signal level = 700 mV in the window at each RGB input
- 3** Crosshatch Picture
 - Squares e.g. 20 mm x 20 mm
 - Outmost lines correspond the active vertical/horizontal video time
- 4** Convergence test pattern
- 5** Focus test pattern

6. Adjustment Procedure

The following procedure must be carried out in case of large service operations e.g. when a circuit board or nonvolatile memory ICA503 has been replaced by a new one.

The order of adjustments explained here has been found to produce the desired result with the minimum of effort. Adjustments can also be made in another order or completely separately.

6.1. Adjustment Flow Diagram

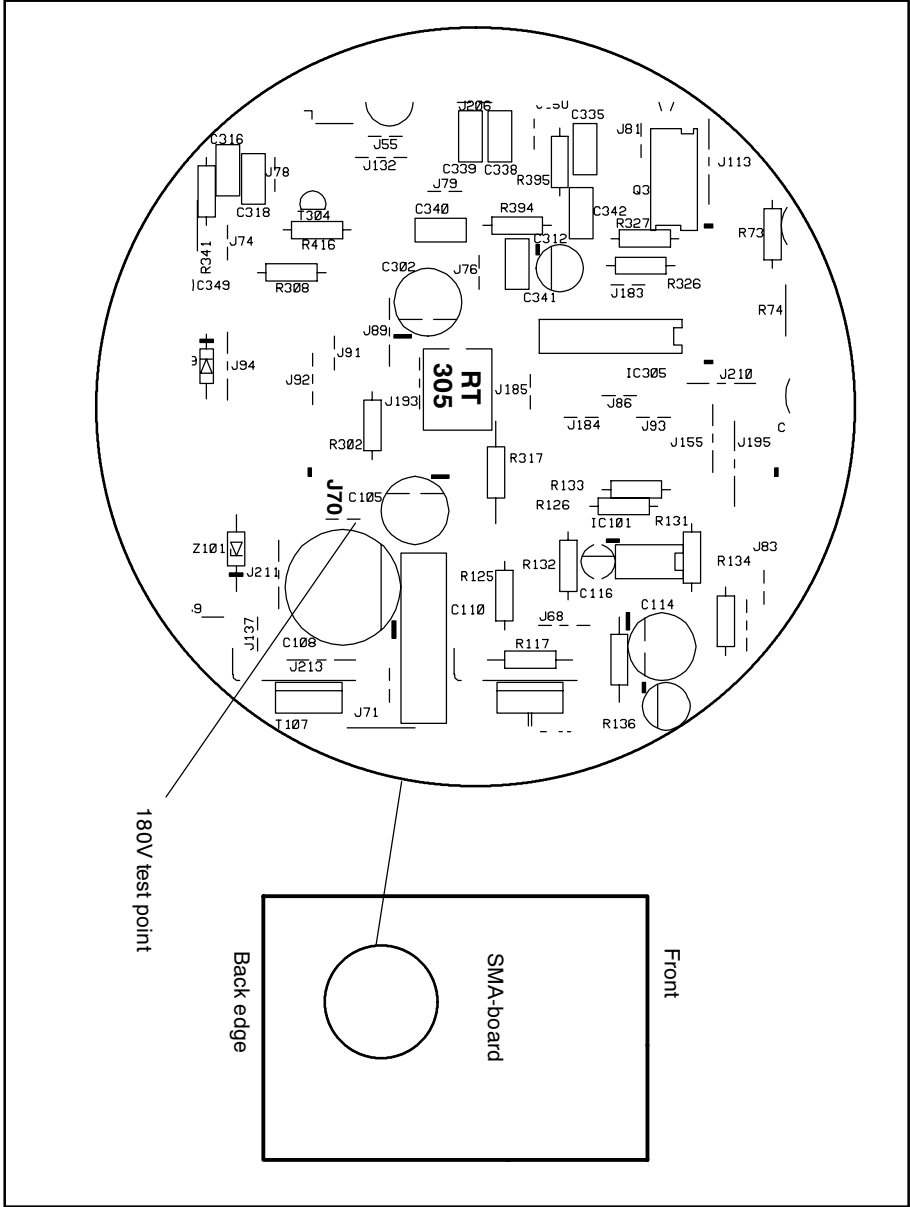


6.2. Preliminary Preparations

Connect the signal cable to the PC. Switch on the monitor and the PC. Let the monitor warm up for 20 minutes before starting the adjustments.

6.2.1. Coarse width

- Select 61 kHz/75 Hz crosshatch test pattern
- Set width to the maximum with menu adjustment
- Set width approximately 326 mm with coarse adjustment **RT305**



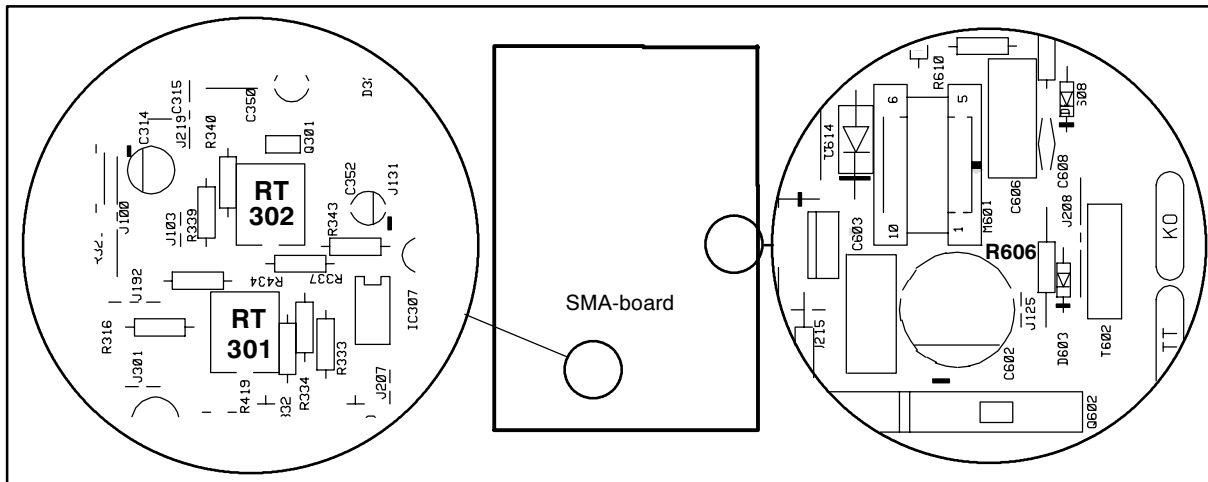
6.2.2. Sync Range Adjustment

This adjustment limits the horizontal frequency range.

Note that the free running frequencies of the phase locked loop controlled oscillator must be adjusted lower than the required limits because the PLL can only increase the free running frequency.

- 1) Short-circuit **Q301** pins on SMA-board. This inhibits the operation of the PLL during adjustment.
- 2) Connect the frequency meter to **R606** and **GND**.
- 3) Select a display mode with line frequency = **80 kHz**
- 4) *Higher limit:* Adjust **RT302** on SMA-board until the meter shows a frequency = **77.0±0.5 kHz**.
- 5) Select a display mode with line frequency = **31.47 kHz**
- 6) *Lower limit:* Adjust **RT301** on SMA-board until the meter shows a frequency = **27.0±0.5 kHz**.

Remember to remove the short-circuit on **Q301**.

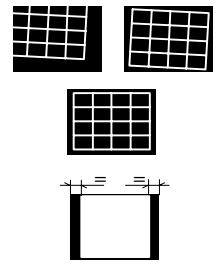


6.3. Geometry

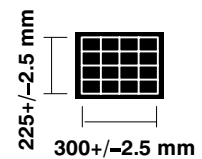
Activate Service Mode.

Degaussing must be carried out before the picture adjustments. Degaussing shall be repeated if the monitor is moved.

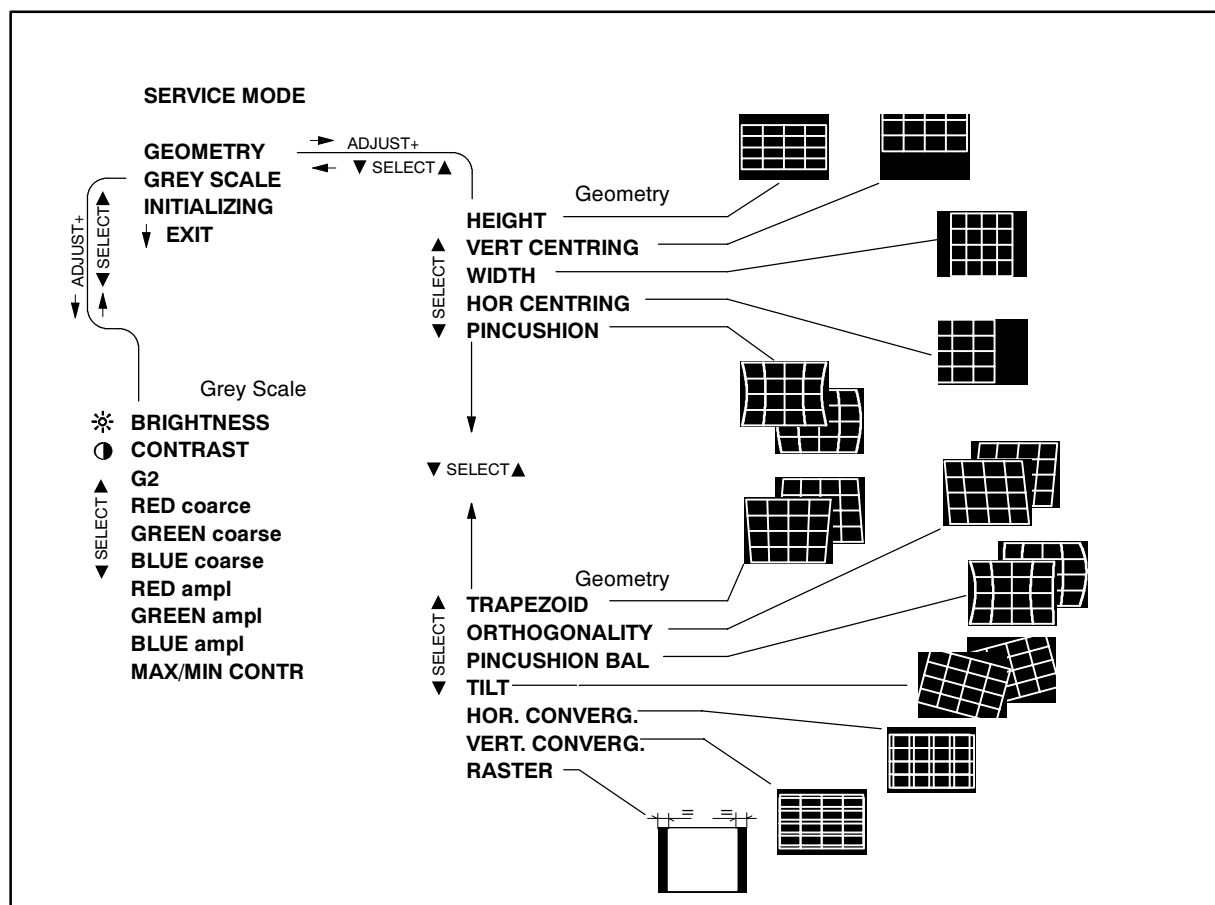
- 1) Select **80 kHz/75 Hz** crosshatch test pattern.
Set **1** to maximum and adjust ***** until the background is faintly visible.
Reduce width until both vertical edges of the **background** are visible.
- 2) Straighten the picture if tilted.
This adjustment is common for all display modes.
- 3) Centre the background.
This adjustment is common for all display modes.



- 4) Adjust size, position and shape of the picture equal to the mask aperture. Adjust first the properties with largest deviation from the correct value.
- 5) Select **61 kHz/75 Hz** crosshatch test pattern
Check that coarse width is still approximately 326 mm
Select **80 kHz/75 Hz** crosshatch pattern
Adjust final width and height.



- 6) Repeat steps 4) and 5) for every display mode to be stored. Note that the display mode can be changed without leaving the service mode.



6.4. Grey Scale

The grey scale is adjusted for 9300K colour temperature. Memorizing of G2 and Max/Min Contrast takes place at the moment of return to the user mode.

6.4.1. The Most Sensitive Colour

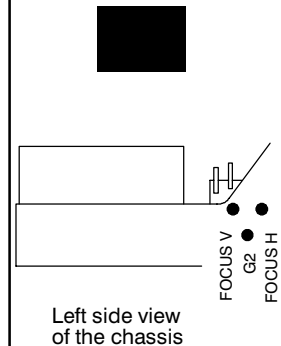
The most sensitive colour has been marked in a label on the deflection yoke. It may not be correct if tube or SMH card has been changed. In that case judge the most sensitive colour from the tone of the picture after you have made the following adjustments.

- 1) Select **80 kHz/75 Hz** black test pattern.
- 2) Set ***** and **●** to maximum.
- 3) Set blacklevel adjustment **RED/GREEN/BLUE coarse** to minimum (for darkest picture)
- 4) Set **RED/GREEN/BLUE ampli** menu adjustments to center
- 5) Set **G2 menu** adjustment to center
- 6) Place the probe of the colour analyzer in the middle of the screen and adjust with **G2 trimmer** until the picture brightness to 8 ± 1 nit.



6.4.2. Low Light

- 1) Select **80 kHz/75 Hz** black test pattern.
- 2) Adjust picture brightness to 8 ± 1 nits with **G2 menu** adjustment.
- 3) Adjust with ***** adjustment the brightness to 1 ± 0.5 nits.
- 4) Adjust the colour coordinates to (9300K)
 $x = 0.281 \pm 0.010$
 $y = 0.311 \pm 0.010$
 with **RED/GREEN/BLUE coarse** adjustments.
Do not adjust the most sensitive colour.
- 5) Set ***** and **●** to the maximum and check that the brightness is still 8 ± 1 nits. If not, repeat steps 3) and 4).



6.4.3. High Light

- 1) Select **80 kHz/75 Hz** black test pattern.
- 2) Adjust with ***** the picture brightness to 1 ± 0.5 nits.
- 3) Select 80 kHz/75 Hz window test pattern.
- 4) Adjust with **●** the picture brightness in the window to 100 ± 5 nits.
- 5) Adjust with **RED/GREEN/BLUE ampli** the colour coordinates in the window to
 $x = 0.281 \pm 0.010$
 $y = 0.311 \pm 0.010$
 Check after adjustment that the brightness reading is in limits.
- 6) Check 6.4.2 para 3) and 4). Readjust color temperature if out of tolerance.



6.5. Maximum/Minimum Contrast

- 1) Set **●** to the maximum.
- 2) Adjust with ***** the picture brightness outside window to 1 ± 0.5 nits.
- 3) Adjust brightness in the window to 160 ± 1 nits with **MAX/MIN CONTR.**
- 4) Set **●** to minimum.
- 5) Adjust brightness to 14 ± 2 nits with **MAX/MIN CONTR.**
- 6) Exit service mode



6.6. Focus

- 1) Select **80 kHz/75 Hz** crosshatch test pattern
- 2) Set **●** to the maximum and adjust ***** until the background is faintly visible
- 3) Adjust the sharpness with **FOCUS H** and **FOCUS V** to optimum
- 4) Adjust ***** until the background is invisible
- 5) Select focus test pattern. Check that all letters are clearly visible



6.7. Convergence

Reduce first the convergence error in the middle of the screen to minimum using static adjustments. After the convergence is faultless in the middle of the tube, use dynamic adjustments to eliminate the error in the edges of the tube.

Static adjustments affects the whole picture area:

- magnet ring set on the tube neck (horizontal + vertical)

Dynamic adjustments affects a part of the picture area:

- deflection yoke trimmers.

6.7.1. Measuring Conditions

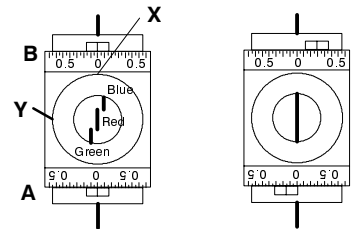
- Adjust convergence with 80.0 kHz line frequency
- Make sure that focus is correctly set at the mid-point between the screen center and the edge of the picture.
- Use white crosshatch test pattern with circle.
- Adjust ● to near the maximum and reduce ✱ until the background disappears.

6.7.2. Convergence Measuring Gauge CM7AR

The use of the Klein CM7AR Convergence Gauge has been explained here but other types of gauges can be used as well.

Check that the adjusting knobs (A & B) are set to zero.

- Place the gauge on the line with marking **Y** up upwards when measuring horizontal line.
- Place the gauge on the line with marking **X** up upwards when measuring vertical line.
- If the line has convergence error, the line in the window seems to be broken.
- Use knobs A and B to adjust the line continuous.
- If the readings are on the opposite side of zero, the convergence error is A+B (e.g. 0.2 + 0.1 = 0.3).
- If the readings are on the same side of zero, the convergence error is equal to A if A > B or B if B > A

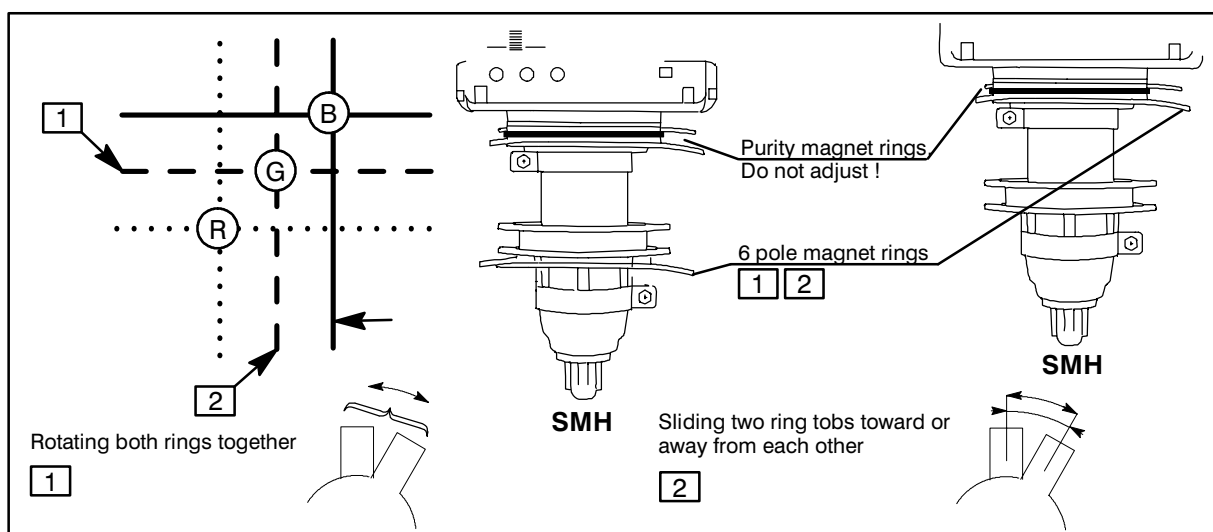


6.7.3. Static Convergence

The magnet rings has been set to the optimum in the factory. Readjustment is necessary only in case the adjusting magnets have been accidentally moved.

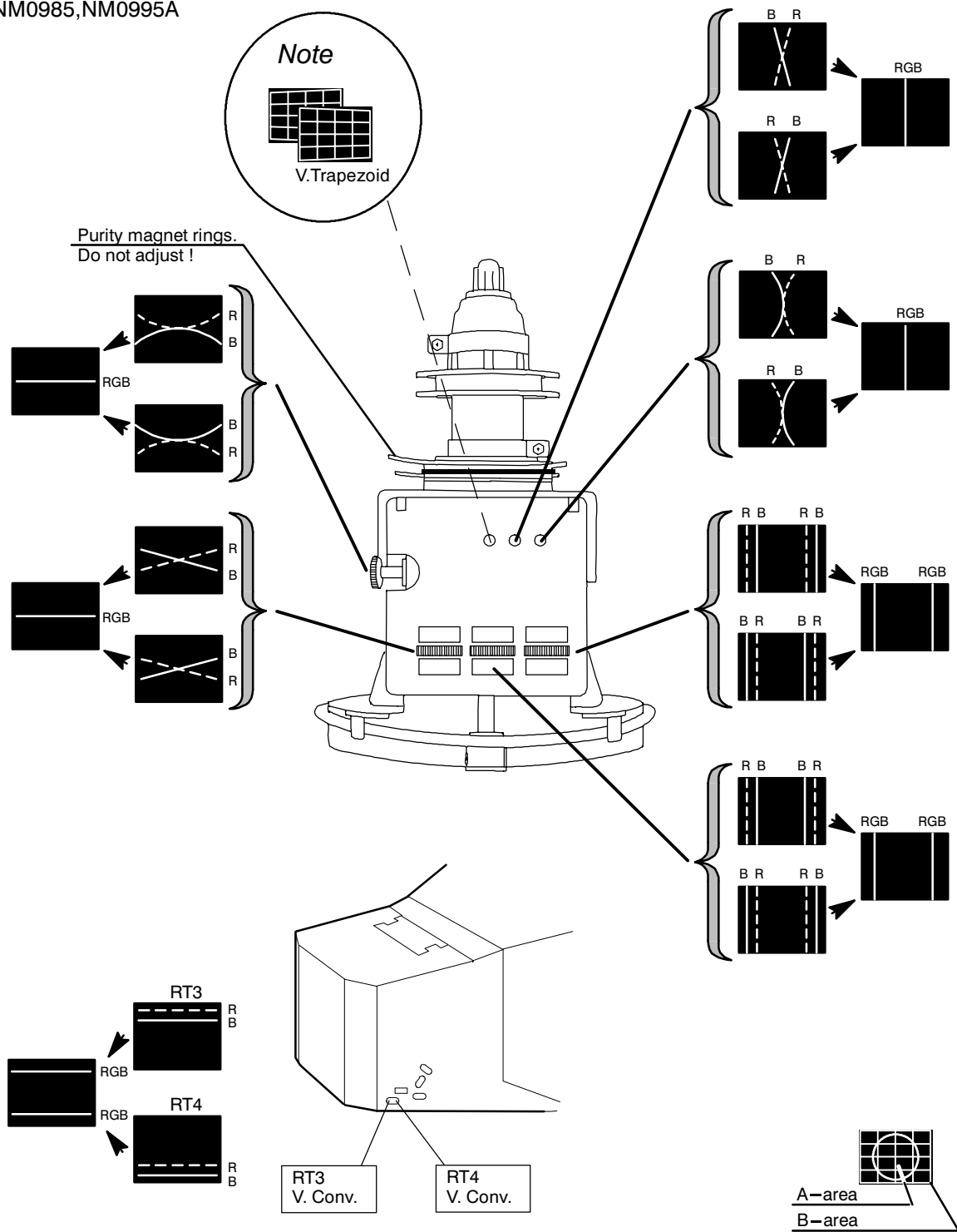
- 1 Adjust G vertically in the middle between R and B with 6 pole magnet rings.
- 2 Adjust G horizontally in the middle between R and B with 6 pole magnet rings.

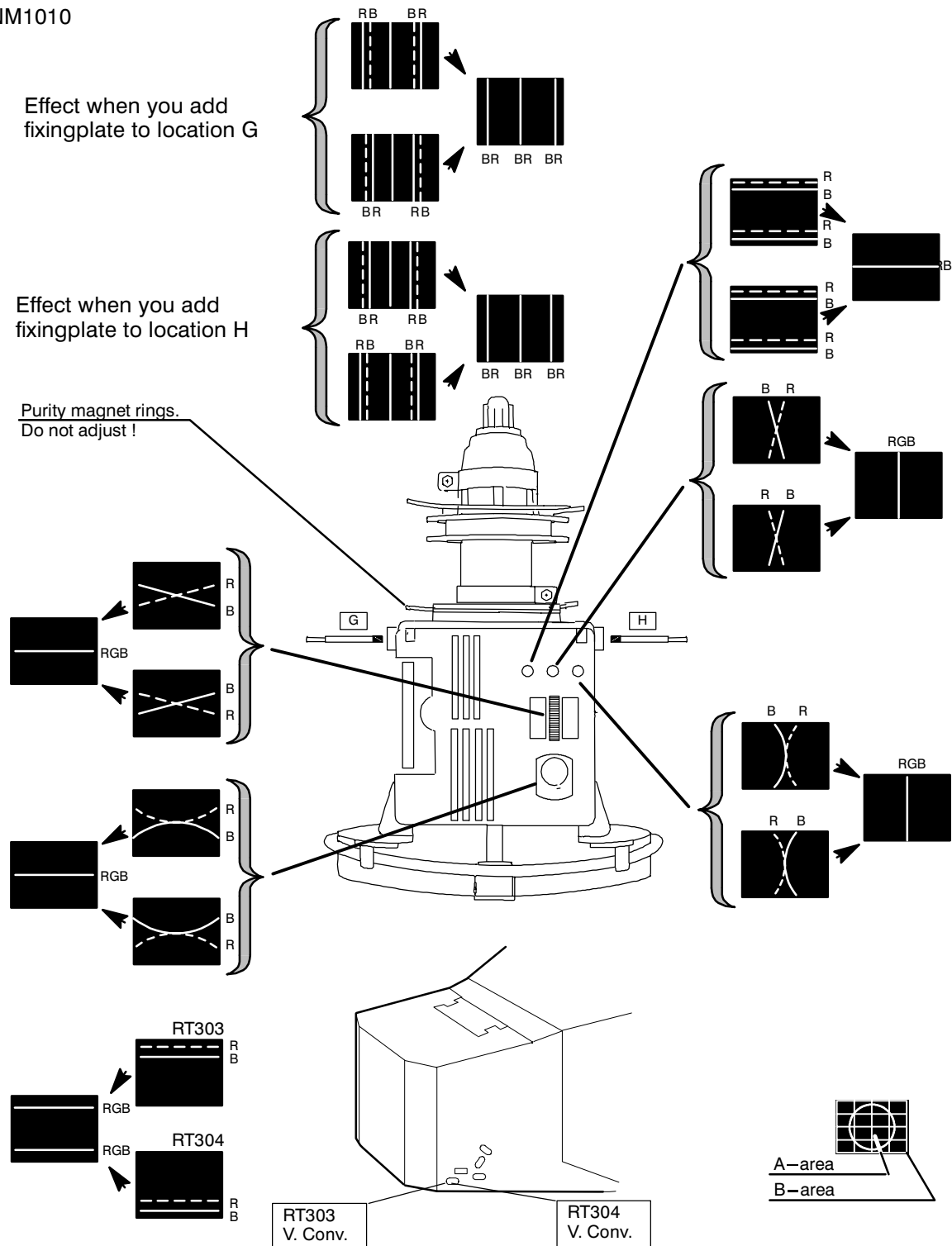
Lock the rings with paint



6.7.4. Dynamic Convergence

NM0985,NM0995A





6.7.5. Allowed Error Levels for Convergence

For horizontal sync frequencies above 58 kHz

Area A: ≤ 0.3 mm

Area B: ≤ 0.4 mm

For horizontal sync frequencies below 58 kHz

Area A: ≤ 0.4 mm

Area B: ≤ 0.5 mm

6.8. Colour Purity

Do not move purity magnet rings. If the purity magnet rings are found to have moved during transportation or handling, set them just in the original position by tracing the locking paint put on purity magnet rings and holder of beam bender and then readjust the static convergence.